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Comparison in Productivity of *Pleurotus ostreatus* Sawdust Spawn Under Different Storage Conditions

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저장기간에 따른 *Pleurotus ostreatus* 톱밥 종균의 생산성 비교

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ABSTRACT: The contamination rates of *Pleurotus ostratus* spawn after 120 days of storage at 5°C and 20°C were 2.1% and 86.5%, respectively. Longer periods of storage resulted in longer culture periods at both temperatures. The yield of oyster mushroom produced from sawdust spawn stored at 5°C was higher than at 20°C, and yields decreased with increasing storage periods.

KEYWORDS: *Pleurotus ostratus*, Productivity, Stored sawdust spawn

In the successful cultivation of any species or variety of mushroom, healthy and productive spawn is a fundamental factor in achieving both quality and yield. It is a widespread practice among spawn makers to store the incubated spawn bags or bottles, in sterile conditions, for a prolonged period at 5°C. Some workers attribute a positive biological effect to such a storage, while others consider it a necessary evil that may only be justified from a business point of view to satisfy the fluctuating demand for spawn (Heltay, 1959). There are many variables controlling spawn production, some genetic and others due to environmental factors (Kneebone, 1967). The vegetative mycelium, maintained by periodic transfer of stock cultures to fresh media, demonstrates a high degree of stability (Lambert, 1959). However, sometimes during the propagation of spawn of *Agaricus bisporus*, serious genetic and physiological changes influencing the characteristics of colony and mycelium took place (Peng and Wu, 1972). Tsai *et al.* (1974) interpreted these results to be the manifestation of biological aging, or senescence. In the study by Sheikh *et al.* (1988), regarding the effect of spawn age and substrate on the yield of *Volvariella volvacea*, old spawn gave higher yields than fresh spawn. Therefore, it is necessary to determine in which direction and to what extent the productivity of sawdust spawn is influenced by its storage period at 5°C and 20°C. In the present study, the quality and productivity of *Pleurotus ostreatus* of stored sawdust spawn was investigated.

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Materials and Methods

Organism

P. ostreatus (ASTI 2194) was obtained from the National Institute of Agricultural Science and Technology, R. D.A. and maintained on potato dextrose agar in the test tubes at 4°C.

Preparation of sawdust spawn and cropping substrate

Poplar sawdust and a rice bran mixture (150 g, 65% moisture content) with a ratio 4 : 1 (v/v) was packed in 250 m*l* Erlenmeyer flasks. The medium was autoclaved at 121°C (1.2 kg/cm^2) for 40 min and then inoculated with pieces of mycelia. The inoculated sawdust was incubated at 20°C for 25~30 days. For preparing the sawdust spawn, poplar sawdust and a rice bran mixture (500 g, 65% moisture content) with a ratio 4 : 1 (v/v) were packed in an 850 m*l* polypropylene bottle. The substrate was autoclaved at 121°C (1.2 kg/cm^2) for 90 min, then cooled at ambient temperature. The substrate was inoculated with 10~13 g of the 250 m*l* Erlenmeyer flask sawdust spawn and at 20°C incubated for 30 days in the dark. After the mycelia were fully grown, they were stored at an ambient (20°C) and a cold (5°C) temperature for 0, 30, 60, 90 and 120 days.

For the preparation of the fruit body cropping substrate, the mixing ratio of pine sawdust, beet pulp, and defatted cottonseed flour was 5 : 3 :2 (v/v). The moisture content of the substrate was 73.8±0.3% by the weight ratio and the filling weight of a bottle of substrate was 555.5±20.0 g

per 850 m*l* bottle. The inoculated substrate was incubated at 20°C for mycelial growth in the dark. The contaminated bottle was observed for pests or pathogens during storage using the naked eye.

Results and Discussion

The contaminated spawn was not detected until day 90 at 5°C, but much earlier, day 60, at 20°C (Fig. 1). At 20°C, the contamination ratio rose 86.5% after 120 days. This high contamination rate was probably due to pathogens invading the old inoculum.

Cultivating periods affected by the storage temperature and period of spawn

Table 1 shows that the storage was also responsible for prolonging the cultivating period. It took 21~26 days for mycelial growth when the spawn used for inoculation was stored at 20°C, while 21~22 days were required when the spawn stored at 5°C. Therefore, the full growth of the mycelia took longer at 20°C than 5°C. The time required for pinhead formation and the fruit body development did not show significant difference between the two groups inoculated with sawdust spawn stored at 20°C and 5°C. From these results, we could speculate that the sawdust stored at 20°C went on ageing for longer than the spawn stored at 5°C and took longer for the mycelial propagation in the sawdust media. Once the mycelial growth was completed, the following development did not seem to be affected a great deal by ageing of the spawn.

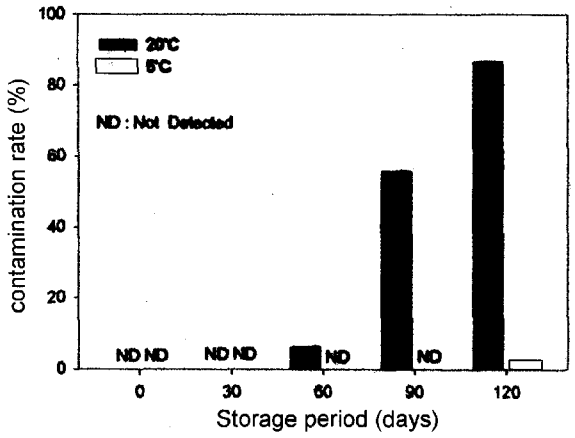

Fig. 1. Changes in contamination rate of *Pleurotus ostreatus* sawdust spawn during storage at 5°C and 20°C.

Table 1. Cropping time table periods of *Pleurotus ostreatus* from sawdust spawn stored at 5°C and 20°C

(unit: days)

Storage temp.	Storage period	Mycelial growth	Pin head formation	Fruit body maturity	Total
20°C	0	21	3	6	30
	30	23	6	5	34
	60	26	5	5	36
	90	25	6	6	37
	120	26	4	6	36
5°C	0	21	3	6	30
	30	21	5	6	32
	60	21	6	5	32
	90	21	7	4	32
	120	22	6	5	33

Effect of storage temperature and period of spawn on fruit body quality and productivity

The data pertaining to the yield and morphology of fruit body of *P. ostreatus*, recorded for a period of 120 days, is shown in Tables 2 and 3.

The number of stipes produced from the sawdust media inoculated with the spawn stored at both 5°C and 20°C was greater than that produced by the control group. However, the stem length of the fruit body produced from the stored spawn was shorter. There was little difference between groups in the diameter of pileus and the moisture content of fruit body, regardless to the storage temperature and time of the sawdust spawn.

As shown in Table 3, the overall yields obtained from the sawdust media inoculated with the spawn stored at 5°C or 20°C were lower than that obtained from the fresh spawn group. The major part of the reduced yield could be attributed to the high contamination rates when the spawn was stored.

Cold storage of mushroom spawn is a common practice in the mushroom industry. Heltay and Barber (1959) found that storage for 68, 128, and 202 days in a refrigerator at -2°C reduced the productivity of the manure spawn by 5%, 6%, and 8%, respectively, when compared

Table 2. Quality of *Pleurotus ostreatus* fruit body from sawdust spawn stored at 5°C and 20°C

Storage temp.	Storage time (days)	Number of stipes (No./bottle)	Length of stem (mm)	Diameter of pileus (mm)	Moisture content (%)
20°C	0	36.6±1.8[a]	75.0 a[b]	26.8±0.7[a]	90.6±0.1[a]
	30	42.0±2.5	63.0 c	24.7±0.6	91.9±0.3
	60	38.7±2.5	63.9 c	25.3±0.6	92.2±0.3
	90	41.6±2.8	69.6 b	24.3±0.6	91.3±0.4
	120	41.9±3.2	65.1 bc	24.6±0.9	91.5±0.2
5°C	0	36.6±1.8	75.0 a	26.8±0.7	90.6±0.1
	30	45.3±3.4	65.8 bc	26.5±0.6	91.6±0.2
	60	49.2±2.8	66.1 bc	25.1±0.5	91.9±0.5
	90	37.5±3.3	65.9 bc	25.5±0.9	91.6±0.3
	120	37.8±3.5	66.8 bc	24.8±1.4	91.3±0.3

[a]Mean values followed by standard error.
[b]Figures with the same letter in the same column are not significantly different at p=0.05 according to Duncan's multiple range test.

Table 3. Productivity of *Pleurotus ostreatus* from sawdust spawn stored at 5°C and 20°C

Storage temp.	Storage period (days)	Fresh weight of fruit body (g/bottle)	Incubation rate (%)	Contamination rate (%)	Yield[a] (g/bottle)	Biological efficiency (%)
20°C	0	120.9 a[b]	96.4	3.6	112.4	83.1
	30	96.5 c	85.7	14.3	70.9	66.3
	60	103.1 bc	68.8	34.8	46.2	70.9
	90	96.6 c	82.1	28.6	56.6	66.4
	120	110.0 b	67.9	32.1	50.7	75.6
5°C	0	120.9 a	96.4	3.6	112.4	83.1
	30	105.1 bc	98.2	5.4	97.6	72.2
	60	102.6 bc	98.2	4.5	96.2	70.5
	90	104.8 bc	93.8	10.7	87.8	72.0
	120	99.8 bc	88.4	15.2	74.8	68.6

[a]Yield=Fresh weight of fruit body × (Incubation rate/100) × 100-(Contamination rate/100).
[b]Figures with the same letter in the same column are not significantly different at p=0.05 according to Duncan's multiple range test.

with fresh manure spawn. The intensity of cropping was also unfavorably affected by storage. Storage was also thought to be responsible for the prolongation of the cropping period. The difference in parameters affecting productivity with storage described in this paper may be an indication of the difference in ageing of an organism. Therefore, the reduced productivity of *P. ostreatus* may be partly attributed to genetic variation (Peng and Wu, 1972) and ageing of the mushroom spawn.

In conclusion, storage temperature and period are two of the most important physiological factors affecting fungal growth and productivity. The morphology and productivity caused by different storage periods and temperatures have been established in this investigation, but further experiments are needed to fully elucidate this problem.

적 요

느타리버섯 종균을 배양 후 저장온도와 저장기간에 따른 잡균오염율, 배양적 특성 및 생산성을 조사하였다. 종균의 잡균오염율은 저온저장은 90일까지 0%였으며 상온저장은 60일에 6.3%였으며 120일에는 86.5%로 증가하였다. 저장 종균을 병재배용 배지에 접종하여 병재배 하였던 바, 균사 배양일수는 상온저장 종균은 21~26일로 저장기간이 길수록 길었으며, 저온 저장종균은 21~22일로 별 차이가 없었다. 저장 종균의 초발이 소요일수는 저장 기간이 길수록 길었으며, 저온저장 종균이 상온 저장 종균보다 1~2일 늦었다. 저장 종균 접종 후 수확까지의 재배기간은 상온저장 종균이 34~37일, 저온저장 종균이 32~33일로 저장기간이 길수록 증가하였다. 자실체 생중은 저장기간이 길수록 감소하였으나 상온저장 종균은 120일 처리에서 높았다. 배양율과 잡균오염율은 상온, 저온저장 모두 저장기간이 길수록 증가하였으며, 이를 감안한 버섯 생산성은 저온저장 종균이 상온저장 종균보다 많았으며 저장기간이 길수록 감소하였다.

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